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## REGRESSION OF × QUERCUS DEAMII TOWARD QUERCUS MACROCARPA AND QUERCUS MUHLENBERGII[1]


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From a genetical standpoint there is of course no reason why oak hybrids should not give true-breeding intermediates, either by segregation, which would require much time, or by doubling of the chromosome number. Before general botanists became genetically conscious there was a tradition, based upon more or less casual observations of nurserymen and others, that oak hybrids came true from seed. This was believed to be true for Bartram's oak, *Quercus heterophylla* Michx. f., from the time of Engelmann (6) until MacDougall (10) showed regression toward the parents in progenies of young seedlings. In *Quercus Rudkini* Britton, another supposed black-oak hybrid, on the contrary, he was unable to demonstrate regression to his satisfaction, although the evidence might have indicated regression toward one of the supposed parents, even if not toward the other.

The usual experience of botanists has been that hybrids are less common in Leucobalanus (the white oaks) than in Melanobalanus (the black oaks). However that may be, gradually increasing numbers of white-oak hybrids have been reported, so that many of the possible combinations are fairly well known or at least suspected to exist. The reports, by Britton and Shafer (1), Bush (2), Hampton (7), Hitchcock (8), Sargent (12; 13), Sudworth (14) and Trelease (15; 16), have not always been supported by satisfactory evidence, even though intrinsically

[1] Papers from the Department of Botany and the Botanical Gardens of the University of Michigan, no. *946*.

credible. It is the purpose of this article to show that one particular white-oak hybrid, × *Quercus Deamii*, is probably *Quercus macrocarpa* × *Q. Muhlenbergii* rather than *Q. alba* × *Q. Muhlenbergii*, as it has been reported to be, and that it shows definite regression toward the supposed parents, but whether by segregation following inbreeding or by out-crossing, or by both processes, there is no evidence.

The subject is one which has been developed by such disconnected reports over so long a time that a writer is tempted either to disregard the background entirely or to swamp a small amount of new information with a disproportionate amount of historical gleanings. Believing that the reader will find the gleanings distinctly useful, they are given as annotations of those cited publications that provide the background for what little knowledge has grown up about hybrids of our East-American oaks in general and our white oaks in particular. Observations have been quoted which have any bearing on the heredity of the peculiar long-appendaged cup scales which make up the distinctive "fringe" of *Quercus macrocarpa*, since the lack of this cup-fringe would seem to be one of the most useful criteria to look for in the search for new examples of bur-oak hybrids. The cup fringe appears to be completely or nearly recessive. Evidence will be found in publications of Bush (2), Hitchcock (8), James (9), Rehder (11), and Sargent (12). Trees with leaves resembling those of *Q. macrocarpa* (if outside the range of *Q. stellata*) but either lacking the fringe or showing it only slightly developed, should be suspected of some degree of hybridity. If possible, acorns or young seedlings should be planted in definitely recorded positions (preferably assured by gift of acorns to some Botanical Garden or Arboretum) where the trees can come to maturity without being again transplanted. The wood of *Q. macrocarpa* is as valuable as that of *Q. alba* (some consider it better) and is frequently confused with it commercially, so every hybrid progeny grown might become a contribution to the timber-tree breeding program of the future.

In 1904 the late Mr. Lent A. Williamson, of Bluffton, Indiana, and his son, Mr. E. B. Williamson, discovered a hybrid oak to which Mr. C. C. Deam subsequently devoted much study. Fertile specimens were collected by E. B. Williamson on October

9, 1904. He was even then primarily a specialist in dragon-flies, and was eventually to become a professional entomologist. The two Bluffton naturalists, Deam and E. B. Williamson, were zealous companions in field work, and since the former was the botanist, it was quite in order that the oak should have been eventually named in honor of Mr. Deam, for it was he who studied and distributed specimens and propagating material of the hybrid and requested opinions of its parentage from a number of his botanical correspondents.

George B. Sudworth, Dendrologist of the U. S. Forest Service, expressed the opinion that the hybrid was *Q. acuminata* × *alba* and the specimens were so labelled. (The name *Q. Muhlenbergii* Englem. is now accepted for *Q. acuminata* (Michx.) Sarg.) Deam (3) described the hybrid in 1911. Subsequently it was named × *Quercus Deamii* by Trelease (15; 16).

After supposedly having been cut, the original tree was rediscovered some years later. In order to secure its preservation in 1915, when it was again about to be cut, Mr. and Mrs. Deam bought the plot of land on which it stands and deeded it to the State of Indiana, which has officially designated specimen and site as the "Deam Oak Monument." The tree which is supposed to be and undoubtedly is the actual type is located about three miles northwest of Bluffton, Indiana, on State Highway 116, and in March, 1939, had a circumference of 90 inches at breast height. Since there may seem to be a possibility of doubt, in view of Deam's statement of 1911 that "an effort was made to save the tree but it was cut a few years afterward," the actual type material may be considered to be the specimens collected by Mr. E. B. Williamson Oct. 9, 1904, which were sent by Deam to the National Herbarium, the writer, and others.

A photograph of the Deam oak was used for the frontispiece of the Flora of Indiana (5). Deam commented that in 1904–5 he had made a collecting trip to Guatemala and at the request of William Trelease of the Missouri Botanical Garden collected Agave and Fourcraea for him. In recognition of this favor and without Mr. Deam's knowledge, Trelease named this tree × *Quercus Deamii*, although Mr. Deam felt that it should have been named for the Williamsons.

The tree has had three of its own nursery-grown seedlings planted about it, and there will undoubtedly be spontaneous seedlings, insuring that the living memorial to Mr. Deam will still remain after the original tree is gone. This pleasant circumstance will inform many a passer-by of Mr. Deam's life-time service to the State and to botanical science, definitively recorded in one of the best state or regional floras hitherto produced in America.

That resolving the problem of parentage of this oak was uppermost in Mr. Deam's mind at the time of its discovery is indicated by correspondence and herbarium specimens showing that he was collecting and studying one of the putative parents, the locally scarce *Q. Muhlenbergii*, at Bluffton, during the same week when Mr. Williamson collected the type material of the hybrid. No seedlings were then obtained from acorns of the latter, for Mr. Deam states in the "Flora" that the hybrid yielded *viable* acorns in 1918, 1927, and 1930. He sent one of the early seedlings (presumably from the crop of 1918) to the Botanical Gardens of the University of Michigan in April, 1926 (accession no. 9385). Later he sent acorns of the 1927 crop (accession no. 12029) from which seven seedlings were obtained, which still survive, although one is a runt which loses its few upper leaves before Fall, finishing the growing season with sprout leaves only. It has undoubtedly suffered from the competition of the three more vigorus seedlings that were planted in the same group with it. At the time of being transplanted from pots to the open garden, the seedlings did not appear any too vigorous, and, in anticipation that not all would live, they were planted in two compact groups, of four and three, respectively. Now, having reached the age of a quarter century, all but the one exceptional weakling have done well, but must now be separated to insure proper development. Inevitably they will suffer a set-back from transplanting and notes are therefore presented herewith on the older seedling and the six of the later planting which have developed normally and have foliage of adult type. These exhibit clear evidence of hybrid segregation toward one of the species which were supposed by Sudworth to be the parents, namely *Quercus Muhlenbergii*. There is no convincing evidence for *Quercus alba* having been the other parent, but, instead, *Q.*

*macrocarpa* Michx. is indicated. Sudworth seems to have made no reference to his opinion in print, at least not before 1917 (14).

The seedlings (aside from the weakling with only abnormal sprout foliage) fall into three groups, as will be seen by inspection of Table I. Two closely resemble Indiana material of *Q. Muhlenbergii*, but the leaves are in general too acute at the base. Otherwise they would undoubtedly, if found wild, go with that species. They differ in leaf width, and have done so consistently, growing together and nearly enough equally developed so that competition has not adversely affected either. Where the branches intermingle the leaf difference is obvious, but in a natural woodland it would probably be considered an environmental effect. Two are fairly close to the original herbarium material from the type tree of × *Q. Deamii*. Three approach *Q. macrocarpa* but do not reach the most extreme development of leaf constriction between a terminal flabelliform segment and a lobate basal segment that is shown by that species. In pure *Q. macrocarpa* the constriction, on one side at least, may reach to the midrib.

Both in the hybrids and in *Q. macrocarpa* the leaf is likely to be markedly asymmetrical, one side having a lateral lobe between the constriction and the big flabelliform end-segment. This extra lobe receives two veins, or, if only one, the latter has a strong downwardly directed branch. The flabelliform end segment of *Q. macrocarpa* may have lobes of the same sort, which are also similar to the lobes of *Q. alba*. The chestnut oaks have simple, evenly spaced teeth, sinuations, or lobes, which correspond to single, non-forked veins.

The acorns might be expected to provide striking evidence of *Q. macrocarpa* being an ancestor of × *Q. Deamii*, instead of (or in addition to) *Q. alba*. These are only beginning to be borne by the seedlings. One resembling *Q. Muhlenbergii* has non-fimbriate acorn cups, like that species. One resembling *Q. macrocarpa* is non-fimbriate, but another shows an intermediate condition, with some few of the marginal scales forming setiform appendages and others not. The fimbriate acorn-cup is characteristic of *Q. macrocarpa*, not of *Q. alba*.

Finally, it will be noted from Table I that none of the hybrids resembles *Q. alba* in having the lower surface of the leaf glabrous.

One (no. 12029–6) on the contrary, has had to be set aside from the others because of having some of the terminal leaves of the season's growth thinly pubescent above, although showing mature characteristics otherwise. Not too much importance can be given to this feature until the tree is separated from two that have greatly outgrown it, by which it is completely shaded. It appears to be genetically of very slow growth, possibly a half-dwarf. The greater persistence of pubescence on the upper leaf surface may, of course, have a genetical basis.

All of the seedlings have grown rather slowly, but the stronger ones have kept up with two seedlings of the tree, exceedingly rare in Wells County, Indiana, which Deam reported in the Flora of Indiana as *Q. macrocarpa* var. *olivaeformis* (Michx. f.) Gray. The circumferences of the seedlings both breast-high and just above the basal swelling are as follows, at the age of 25 years:

No. 12029–1: 53 cm.; 76 cm.
No. 12029–2: 29 cm.; 40.5 cm.
No. 12029–3: 26 cm.; 35.5 cm.
No. 12029–4: 45.5 cm.; 61.5 cm.
No. 12029–5: 36 cm.; 48 cm.
No. 12029–6: 23 cm.; 30 cm.

The leaf form of type material of × *Quercus Deamii* (in herb. Univ. Mich. *ex* herb. Bartlett) indicates clearly that one of the chestnut oaks was a parent (or ancestor) and this parent would reasonably seem to be *Quercus Muhlenbergii* (= *Q. acuminata*). The latter, known as sweet oak in northern Indiana, is the only chestnut oak found in Wells County. The basket oak, *Quercus Michauxii* (unfortunately, with possibility of vast confusion, it may be necessary to accept the long misapplied name *Q. Prinus* for this, as Fernald does in the current edition of Gray's Manual) is found only in the southern counties. *Quercus montana* does not extend northward even to the center of the state, and *Quercus prinoides* has been found only in one county of the northern tier. So if × *Q. Deamii* is a primary or even recent hybrid, the evidence from geographic distribution points inevitably to *Q. Muhlenbergii* as the chestnut-oak parent. This would account for the acute or subacute dentition, and likewise the narrow leaves of the most extreme segregate toward *Q. Muhlenbergii*, which is, in fact, an almost perfect match. This and at least one other seedling deviating toward *Q. Muhlenbergii*

TABLE I. Characteristics of × *Quercus Deamii*, its probable parents, *Q. Muhlenbergii* and *Q. macrocarpa*, and progeny of the type tree of the hybrid, from uncontrolled pollination, including median plants and others deviating strongly toward the supposed parents, as a result of segregation or secondary crossing.

| | Leaves evenly dentate or sinuate-dentate. | Blades having some deep irregular lobes, with mere suggestion of terminal flabelliform segment. | Blades with deep constriction below terminal flabelliform segment. | Blades at maturity subglabrous to glabrous above, velutinous below | Blades at maturity soft-pubescent to glabrate above, velutinous below. | Petioles glabrous. | Petioles minutely puberulent, at least above. | Petioles thinly to conspicuously coarse-pubescent. | Persistent subulate stipules longer than terminal buds. | Bud scales subglabrous. | Bud scales ciliate and more or less pubescent. | Bud scales pilose. | Twigs of the year essentially glabrous. | Twigs of the year minutely puberulent. | Twigs of the year moderately coarse-pubescent. | Acorn cups thin-margined, not fimbriate. | Acorn cups with trace of fimbriation. | Acorn cups fimbriate. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Q. Muhlenbergii** | + | | | + | | + | | | | + | | | + | | | + | | |
| No. 12029–1 | + | | | + | | + | | | | + | | | + | | | + | | |
| No. 12029–2 | + | | | + | | | + | | | | + | | | + | | | | |
| × *Q. Deamii*** | | + | | + | | | + | | | + | | | | + | | + | | |
| No. 9385 | | + | | + | | | | + | + | | | + | | | + | | + | |
| No. 12029–3 | | + | | + | | | | + | + | | + | | | | + | + | | |
| No. 12029–4 | | | + | + | | | | + | | | + | | | | + | + | | |
| No. 12029–5 | | | + | + | | | + | | + | | + | | | + | | + | | |
| No. 12029–6 | | | + | | + | | | + | + | | | + | | | + | | | |
| *Q. macrocarpa**** | | | + | + | | | | + | + | | + | | | | + | | | + |

* A specimen from Wells County (Deam, *s. n.*) collected on Oct. 4, 1904 for comparison with type material of the hybrid, collected a few days later by Mr. Williamson.

** Cotype of the hybrid collected Oct. 9, 1904 by E. B. Williamson (in Herb. Univ. Mich.).

*** A specimen from Ann Arbor, Michigan, collected by H. H. Bartlett (tree spontaneous in the Botanical Gardens).

are considered to have arisen by true hybrid segregation from × *Q. Deamii*, for the chestnut-oak parent is so scarce in Wells County as to make it seem hardly probable that it would have contributed the pollen for a new cross with × *Q. Deamii*. On the contrary, it would seem logical to interpret seedlings deviating toward *Q. Muhlenbergii* to be segregates rather than back-crosses.

Other seedlings, deviating toward *Quercus macrocarpa*, might logically be interpreted as new hybrids between × *Q. Deamii* and *Q. macrocarpa*, if there were any real evidence that *Q. alba* had been one of the parents of the original hybrid, but there is no such evidence. Nevertheless it must be admitted that the evidence does not conclusively rule out *Q. alba* as having been the other parent.

So far as Mr. Williamson's herbarium material of Oct. 9, 1904 indicates, the parentage of × *Q Deamii* might well have been as originally indicated. The four to six lateral lobes of the leaves, however, are actually but not conspicuously grouped above a vague constriction into a terminal flabelliform group, only a weak imitation of the condition in *Quercus macrocarpa*. There are a few duplex lobes containing two secondary veins or a single secondary with one or two downwardly directed tertiaries. Such lobes are indeed strongly characteristic of *Q. alba*, but may be found in *Q. macrocarpa* as well. Even the strong approach of seedlings to *Q. macrocarpa* need not certainly indicate that *Q. alba* was not more remotely an ancestor.

The pubescence of the hybrid and all of the seedlings cannot be held to rule out *Q. alba*. The latter is the only almost consistently glabrous white oak of the region, so it might be argued that some of the seedlings should be glabrous by segregation or back-crossing if *Q. alba* were involved. The progeny is too small for negative evidence to have any value, and might have no genetic validity anyway, in view of the fact that interacting factors for pubescence are indicated by one of the seedlings being more pubescent than any presumptive parent. So the unestablished parent of × *Q. Deamii* might as well be another markedly pubescent one, even though *Q. alba* may carry genes for pubescence which would be activated in a hybrid by interacting factors, or perhaps by dilution of the effect of inhibiting factors.

Although *Quercus alba* tends to be consistently glabrous, pubescent sprout leaves often show that factors for pubescence are present, but suppressed under the physiological conditions that result in the normal foliage of mature growth.

Among his Indiana specimens of *Quercus alba* Deam mentions only one that is pubescent. (It might be a hybrid with *Q. bicolor*.) It is on the whole not much of an argument that the small number of seedlings show none resembling *Q. alba* in having essentially glabrous leaves. Interacting factors of even two glabrous types might give pubescence. For what the argument is worth, there is one seedling of × *Q. Deamii* that has some mature leaves velutinous above as well as below. It would explain this fact most simply, in view of the close approach of some seedlings to the leaf form of *Q. macrocarpa*, and a suggestion of such form in the original hybrid, if *Q. macrocarpa* was tentatively taken to be the presumptive other parent of × *Q. Deamii*, which would then be *Q. Muhlenbergii* × *Q. macrocarpa*.

The argument, however, cannot be considered, *a priori*, as genetically sound. An isolated hybrid, primary or of a later generation, might have been so nearly self-sterile as to be only partly self-pollinated, and partly cross-pollinated by other species. So a primary hybrid *Q. Muhlenbergii* × *alba* might have set some fruits by self-pollination, and thus segregated toward the scarce or sporadically occurring *Q. Muhlenbergii*, but might at the same time have set other fruits by hybridization with *Q. macrocarpa*, producing a new hybrid resembling the latter, except in lack of the fimbriate acorn fringe, which is probably recessive or nearly so. Certainly *Quercus macrocarpa* is primarily or secondarily involved in the ancestry of those seedlings in which the leaves show the form so characteristic of the bur oak, a flabellately lobed terminal segment above a narrow constriction that occurs below the middle of the lamina and extends in extreme variates practically to the midvein.

It is to be feared that knowledge of oak genetics will grow with surpassing slowness. In the meantime, lacking precise knowledge of the parentage of hybrids, we should prefer the simplest hypotheses that seem to account for the facts. Since there is no single feature of the original tree or of the progeny of × *Quercus Deamii* that supports the hypothesis that it was *Q. Muhlenbergii*

× *Q. alba* rather than *Q. Muhlenbergii* × *Q. macrocarpa*, the latter hypothesis seems the more likely, for it explains all the known facts and is simpler. A cytological examination of the hybrids and their possible parents would perhaps throw light on the problem, without actually making the various hybrid combinations experimentally. The latter attack would be justified in view of the practical values that might come from plant breeding experiments in such a valuable group as the white oaks. Another experimental approach that is being neglected in such problems is the serological. Findings might, indeed, be negative, but differences among the proteins of such different and ancient lines of descent as those of *Q. alba*, *Q. Muhlenbergii* and *Q. macrocarpa* might be expected to be revealed by serological experimentation, and might help in indicating the course of evolution of plants which could not be subjected to rigorous genetical study except at altogether prohibitive expense. The white oaks, to be sure, are economically so important as to justify the attention of practical plant breeders.

The isolated hybrid oaks, to which systematists call attention, are by no means unworthy of the attention they receive. They demonstrate the possibility of wide interspecific hybridization, and the systematist cannot be unmindful of the genetic diversity between regional populations of what are considered wide-ranging species that may be caused by opportunity for hybridization in different parts of a broad range with entirely different species. Segregates from crosses and back-crosses doubtless produce blending populations that are geographically distinguishable. Some localized species may become so blended that original forms can only appear as segregates from a hybrid population. The interpretation of an aberrant or hybrid oak without experimental evidence is as difficult as guessing at the racial origin of human traits in a mixed population. The world flora, however, contains many thousands of species that are ill-adapted to genetical study. Many cannot be or never will be subjected to experimental breeding, and it will remain the obvious function of the systematist in the future as in the past to classify as best he can, making such use of genetical or other experimental findings as may seem applicable by analogy.

## Annotated Bibliography

1. Britton, N. L. and Shafer, J. A. North American Trees. New York, 1908.

Here there is no discussion of white-oak hybrids but only a vague reference under *Q. alba* to a hybrid with *Q. Muhlenbergii* from Missouri and Illinois. Presumably the allusions are to Bush (2) and Sargent (12).

Reference to this work by Trelease (15) precedes the one to Deam's publication (3) and obscures Trelease's intention regarding typification of *Q. Deamii*. Although Trelease made a great point that stability of nomenclature would be assured by binomial names for hybrids, he was singularly uncritical about the designation of types. His binomial names must be typified by guess as to his intentions.

2. Bush, B. F. Hybrid oaks in western Missouri. Garden & Forest **8:** 32–33. 1895.

Reports, (1) *Q. alba* × *Q. macrocarpa* from Courtney, Jackson County, Missouri, with foliage of *Q. macrocarpa* and fruit plainly that of *Q. alba;* (2) *Q. alba* × *Q. Muhlenbergii*, clearly of the indicated parentage, but, according to Britton, "the fruit was exactly of the eastern *Q. Prinus*," i. e., *Q. montana;* (3) *Q. alba* × *Muhlenbergii;* (4) *Q. macrocarpa* × *Q. Muhlenbergii*, from Independence, Missouri, with no fringe on the acorn cup; (5) *Q. macrocarpa* × *Q. bicolor*, several trees in a grove of *Q. bicolor* where *Q. macrocarpa* was not present. Every mention of the acorn cup verifies the other evidence that the presence of a fringe on the acorn cup is recessive.

3. Deam, Charles C. Trees of Indiana. *In*, State of Indiana, 11th Annual Report of the State Board of Forestry, 1911. Indianapolis, 1912 (pp. 86–372).

Contains the original description and drawing of the hybrid *Q. Muhlenbergii* × *macrocarpa* upon which Trelease (15; 16) is assumed to have based × *Quercus Deamii*, although he made no reference to Deam's description and cited no specimen in the earlier of the two publications (15).

4. Deam, Charles C. Trees of Indiana (First revised edition). Department of Conservation, State of Indiana (Indianapolis) 1921.

Description and illustration of *Quercus alba* × *Mulhenbergii* (× *Quercus Deamii* Trelease). "This rare hybrid . . . in 1918 bore a heavy crop of seed. A liberal quantity was sent for propagation to the Arnold Arboretum, New York Botanical Gardens, and Missouri Botanical Gardens. The Arboretum succeeded in germinating several seed. The New York Gardens succeeded in getting five seedlings. The Missouri Gardens

failed to get any to germinate. About a gallon of seeds was planted in the Clark County State forest nursery and all failed."

5. DEAM, CHARLES C. Flora of Indiana. Department of Conservation, Division of Forestry, Indianapolis, 1940.

In addition to the information on × *Q. Deamii* Trelease, this flora has a reference to × *Q. Hillii*, of which a single Indiana tree, as reported by Sargent, was found by Hill near Roby, Indiana, and supposed to be *Q. macrocarpa* × *Q. Muhlenbergii*. Deam states: "I have a duplicate specimen but I believe it is only a specimen of the bur oak. I question the determination of this specimen because the last named parent of the hybrid does not occur there, or, if it does, is extremely rare."

6. ENGELMANN, GEORGE. About the oaks of the United States. Trans. St. Louis Acad. Sci. **3:** 372–384. 1876. 385–400. 1877. 539–543. 1877.

Engelmann, the most discriminating student of the oaks in his day, stated (pp. 397–398): "All the supposed hybrids are abundantly fertile . . . The seedlings of such questionable individuals do not seem to revert to a supposed parent, a sport of which they might be claimed to be, but propagate the individual peculiarities of the parent; 'come true,' as the nurserymen express it. For how many generations this may continue, and whether in time forms approaching one or the other parent may not appear, remains to be seen. At the same time it is a remarkable fact, that, notwithstanding their fertility, they do not seem to propagate in their native woods; we may properly ascribe this to a lesser degree of vitality in the hybrid progeny, which causes them to be crowded out in the struggle for existence: one of the provisions of nature to keep the species distinct, or, as Dr. Gray suggests, fertilization by one of the parents may soon extinguish the hybrid characters. I find ten forms . . . which I consider as real hybrids; of them only a few, often only single individuals have become known. Their existence cannot well, without straining facts, be considered due to innate variability in the supposed parents . . . Among the White-oaks hybrids seem to be much rarer than among the Black-oaks, or it may be that they are more difficult to discover."

Engelmann's belief that the interspecific hybrid oaks "bred true" although with a greater range of variation than non-hybrids, seems to have been based upon nurserymen's experience with two black-oak hybrids. One of them, his own discovery 8 miles west of St. Louis, was *Q. imbricaria* × *Q. palustris*. He said: "It had, unfortunately, to give way to a railroad track, but ripe fruit was obtained which to Mr. Meehan of Germantown has furnished fine young plants, completely agreeing in character with the parent." The other was × *Q. heterophylla* Michx. discovered near Philadelphia by Bartram. Even in Michaux's time the original tree had been destroyed, but, as Engelmann said (p. 541) "its offspring was introduced into Europe, and the trees now seen in Bartram's

## Explanation of Plates

Plate 1176. Progeny of type tree of × *Quercus Deamii*. Upper 7 leaves: range of variation in the segregate most resembling *Q. Muhlenbergii* (Mich. Bot. Gard., No. 12029–1). The lateral veins have no irregularity of branching, each leading to a tooth. The acorns have no fringe, and the peduncles are less than 1 cm. long. Lower 5 leaves: the other segregate showing regression toward *Q. Muhlenbergii* (No. 12029–2). Leaves relatively broader; lateral veins with one or two upward or downward branches of irregular strength, or sometimes a fork from the midvein, directed toward the sinuses. Rarely an independent but weaker lateral vein reaches a sinus.

Plate 1177. × *Quercus Deamii*. Specimen of the original collection by E. B. Williamson, 9 Oct. 1904, from the type tree near Bluffton, Indiana (Herb. Univ. Mich.). This represents a degree of intermediacy between *Q. Muhlenbergii* and *Q. macrocarpa* that less resembles the former than do the specimens shown in Plate 1. It is perhaps nearer *Q. Muhlenbergii* than *Q. macrocarpa*, and entirely destitute of the acorn-cup fringe characteristic of the latter.

Plate 1178. Progeny of type tree of × *Quercus Deamii*. The oldest seedling (from acorn crop of 1918) at Mich. Bot. Gard. (No. 9385). The leaf form distinctly shows regression to *Q. macrophylla*, but the constriction below the flabelliform terminal part of the leaf is not deep enough to be typical. The terminal group of crenations are served by lateral veins, and the branches of the latter to the sinuses are extremely weak. The deep sinuses of the lower part of the leaf are mostly served by independent laterals, bifurcated below the sinus. The irregular deep median and lower leaf lobes are often entered by two lateral veins, which have one or two strong branches or are forked. The acorn cups are not fringed from most of the marginal scales, but only weakly from a few.

Plate 1179. Progeny of × *Quercus Deamii*. Upper 6 leaves from a seedling (No. 12029–3) showing definite regression toward *Q. macrocarpa*. Lower four leaves (from seedling no. 12029–4) show even more definite regression toward *Q. macrocarpa* but the young acorns have *no* cup fringe. For this important characteristic there is apparently independent segregation. The peduncles are about 2 cm. long.

Plate 1180. Progeny of × *Quercus Deamii*. Upper 3 leaves (no. 12029–5) show forms which would indicate complete regression of the hybrid to *Q. macrocarpa* if it were not for the contradictory characteristics of the acorn. The young acorn cup lacks a fringe, and thus resembles that of *Q. Muhlenbergii*. The peduncles range from 2 to 16 mm. in length. Lower 4 leaves: the smallest of the seedlings, perhaps a half-dwarf, showing pronounced resemblance in leaf form to *Q. macrocarpa*, but a greater tendency to retain velutinous pubescence on the upper leaf surface. This may possibly be a juvenile characteristic retained because of shading and suppression of growth by companion trees in the same group.